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SECOND TAXONOMIC STUDY OF CALIFORNIA MEALYBUGS, WITH DESCRIPTIONS OF NEW SPECIES

(Homoptera: Coccoidea: Pseudococcidae)¹

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INTRODUCTION

SEVERAL UNDESCRIBED species of California mealybugs have been discovered since the author published his *Taxonomic Study of California Mealybugs, with Descriptions of New Species*.³ Some of these new forms have been found after an examination of countless slide preparations represented in several Coccoidea collections, while others have been collected in the field by various county, state, and university personnel. Recently, some interesting mealybug recoveries have been made from soil samples processed in Berlese traps. As a matter of fact, of the 13 pseudococcid species herein described as new, 4 were taken from this type of trap. Adaptation of this procedure for collecting mealybugs has provided a new way to gather information about the mealybug fauna of California. It is contemplated that in the future more emphasis will be placed on this method of collecting.

The purpose of the present study is to describe and illustrate new California species of mealybugs, and to comment, if necessary, on the taxonomic status of other named forms occurring in the state. Ultimately the descriptions presented in the first study mentioned above, and the new information herein presented, will be assembled in a systematic dissertation on California species of mealybugs. The number of new species for California described by the two studies now totals 41.

Since a key to genera of North American Pseudococcidae was presented in the first publication of this series, a revision of this appears to be unnecessary at present. However, the keys to certain North American genera are amended to include the new forms herein described. No doubt these keys will again need modification when the final publication appears.

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³ Published in *Hilgardia* 29 (15) :681-770, illus., 1960.

- 15 (14). Multilocular disk pores present ventrally in sternal region of thorax; penultimate cerarii with auxiliary setae *microporus* McKenzie
Multilocular disk pores absent ventrally in sternal region of thorax; auxiliary setae in penultimate cerarii lacking *peregrinus* (Green)

***Chorizococcus polyporus* McKenzie, new species**

(Figure 1)

Suggested common name. Many-pored mealybug.

Hosts and distribution. Type and paratype adult females of this species were collected from the soil beneath *Juniperus* sp., Cajon Pass, San Bernardino County, California, April 15, 1960, by Uzi Nur and H. S. Chandra. A Berlese trap was used to recover the mealybugs from the soil. The soil had much organic matter and, in addition to juniper, supported two (2) plant species: *Eriogonum fasciculatum* [ssp.] *polifolium* (Polygonaceae), and *Sitanion hystrix* (Gramineae). It is suspected that this mealybug was feeding in the crown or on the roots of *Eriogonum*, although additional field evidence is needed to substantiate this.

In addition, specimens have become available that for the present may be placed with this species, these collected on *Baccharis* sp. (Compositae), at Indio, Riverside County, California, March 26, 1939, by R. C. Dickson. Certain of these mealybugs may completely lack, or have only 1 to 3, ventral multilocular disk pores on fourth abdominal segment. However, in all other respects they appear quite typical of *polyporus*, and are here associated with this species.

Type material. Holotype adult female (1 specimen mounted on 1 slide), and paratypes have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis, California. Paratypes have also been placed in the United States National Collection of Coccoidea at Washington, D.C., in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento, California, and in the museum collection of Stanford University, California.

Habit. Found in soil beneath *Juniperus* sp. It is suspected that the mealybug may feed within the sheathing leaf base in the crown or on the roots of *Eriogonum fasciculatum* since the soil sample was associated with this plant. It is doubtful that this mealybug infests grass roots.

Recognition characters. Length of largest available specimen approximately 2.40 mm, noted range from 1.50 mm to 2.40 mm. On dorsum number of cerarii reduced, normally only 3 or, at most, 4 pairs which are recognizable when counted forward from the anal lobes. Anal lobe cerarius with 2 small, slender, conical cerarian spines, 3 or 4 slender auxiliary setae, and a few scattered trilocular pores; remaining cerarii with but 2 conical setae, these progressively smaller, more slender, and often more widely separated than anal lobe pair, no auxiliary setae, and with scarcely any concentration of trilocular pores. Dorsal body setae all small and slender. Dorsum with numerous oral rim tubular ducts. These structures especially abundant on abdominal segments, except the last, forming transverse band of 2 irregular rows, these bands containing a total of as many as 18 to 35 ducts. Trilocular pores distributed over entire dorsum. Anal ring of normal size for genus, with its setae about twice as long as diameter of ring itself.

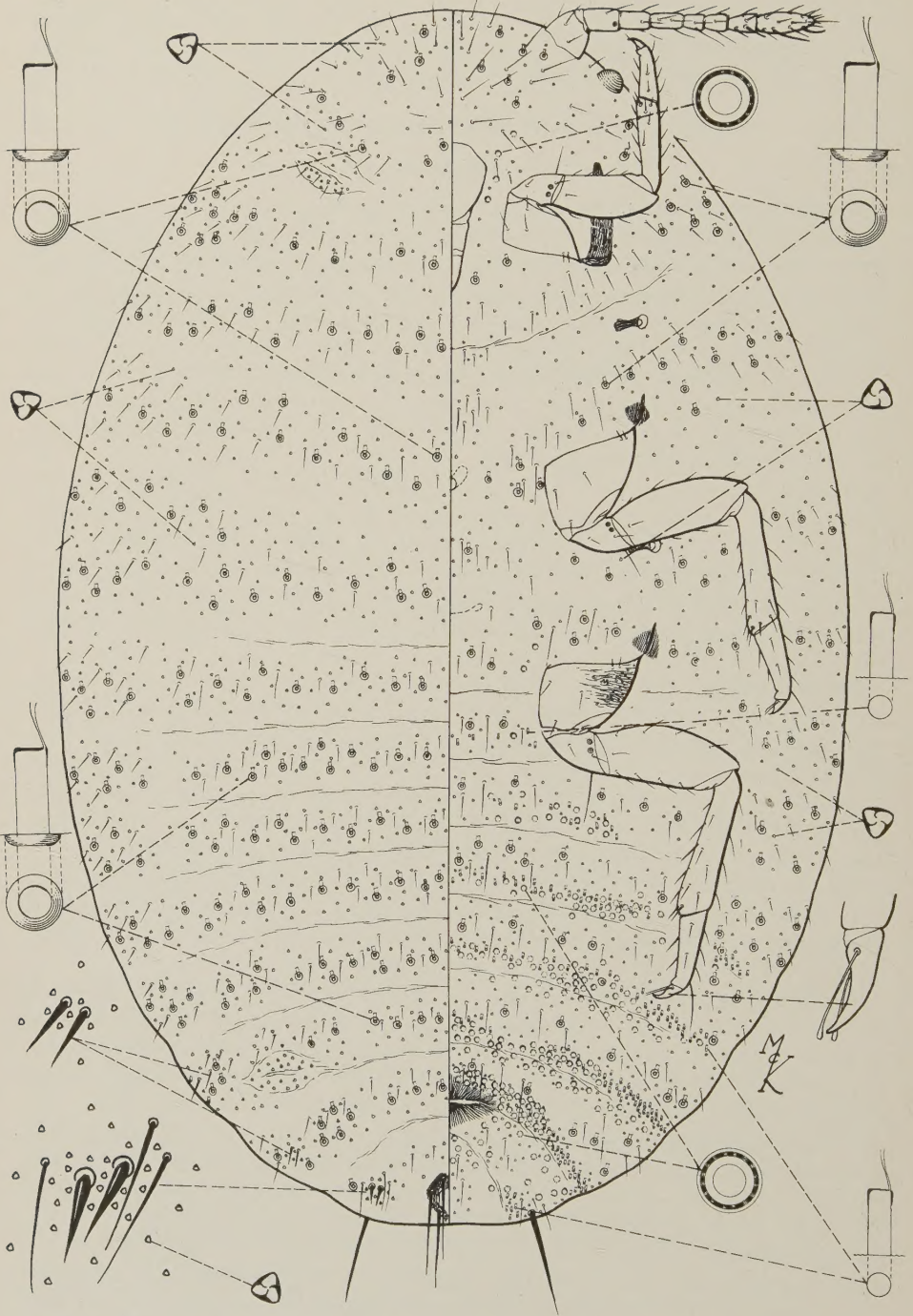


Fig. 1. *Chorizococcus polyporus* McKenzie, new species, collected from soil beneath *Juniperus* sp. (Pinaceae), Cajon Pass, San Bernardino County, California.

On ventral side, multilocular disk pores abundant on all abdominal segments, especially so on fifth to eighth segments, a few of these evident near mouth parts. Oral collar tubular ducts present on abdomen, numerous along lateral areas of the body. Oral rim tubular ducts, of same size as those of dorsum, quite numerous on head and thorax, especially so on all abdominal segments, except the last. Ventral body setae slender and generally longer than those of dorsum. Trilocular pores numerous and generally distributed over venter.

Circulus lacking. Antennae relatively short, normally 7-segmented. Legs comparatively large, well-developed; hind coxae with a cluster of translucent pores at base; claw without denticle or tooth on plantar surface. Mouth parts short though moderately slender.

NOTES. This species appears to be closely related to *Chorizococcus wilkeyi* McKenzie, but differs in possessing far more numerous dorsal and ventral oral rim tubular ducts (hence the specific name, *polyporus*), possesses ventral multilocular disk pores on abdominal segments 2 to 4, has shorter and stouter legs, and a 7-segmented antenna. *C. wilkeyi*, on the other hand, has fewer dorsal and ventral oral rim tubular ducts, lacks multilocular disk pores on venter of abdominal segments 2 to 4, possesses long, slender legs, and normally an 8-segmented antenna.

Chorizococcus wilkeyi McKenzie

This species was originally described from specimens collected on *Agoseris grandiflora* (Compositae), 8 miles west of Placerville, El Dorado County, California. Recently, additional examples of the species were taken on *Eriophyllum lanatum* var. *grandiflorum* (Compositae) at Oroville, Butte County, California, April 20, 1960, by D. Black and L. Heinricks (Calif. State Dept. Agr. #60E16-7). It is reasonable to assume that this mealybug occurs on still other members of the Compositae.

Chorizococcus wilsoni McKenzie, new species

(Figure 2)

Suggested common name. Wilson mealybug.

Hosts and distribution. Type and paratype adult females of this species were collected on galls of *Juniperus* sp. (Pinaceae), 7 miles west of Coalinga, Jacalitos Canyon, Fresno County, California, April 19, 1960, by H. L. Wilson (Calif. State Dept. Agr. #60E9-1). An additional paratype adult female was collected on *Juniperus* sp., Rosamond, Kern County, California, April 19, 1960, by G. G. Beevor (Calif. State Dept. Agr. #60D25-29).

Type material. Holotype adult female (1 specimen mounted on 1 slide) and paratypes of this species have been deposited in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento. Paratypes have also been placed in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. Collected on juniper galls and twigs.

Recognition characters. Length of largest available specimen 2 mm, noted range in size 1.50 to 2 mm. On dorsum number of cerarii reduced, normally

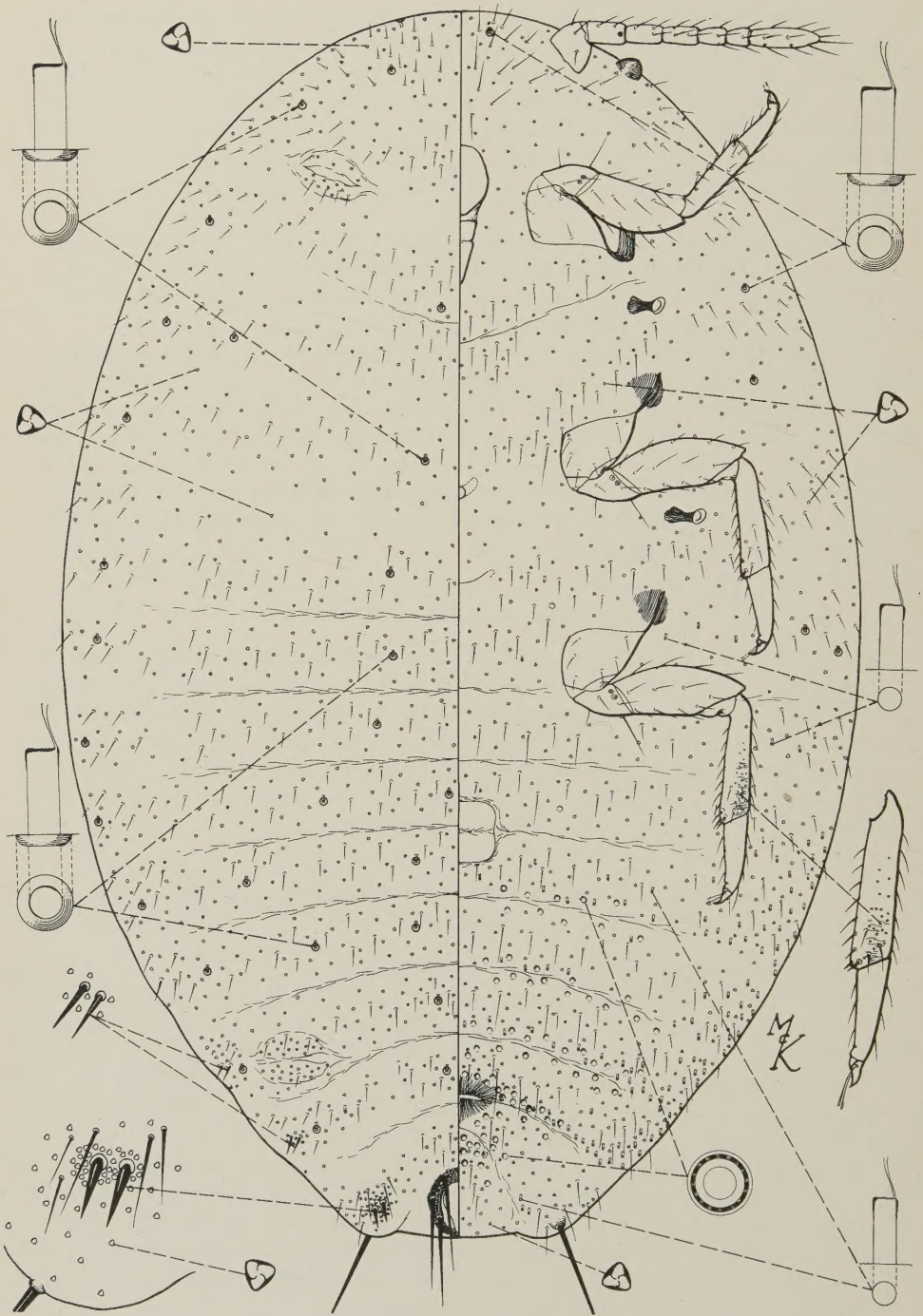


Fig. 2. *Chorizococcus wilsoni* McKenzie, new species, collected on galls of *Juniperus* sp. (Pinaceae), 7 miles west of Coalinga, Jacalitos Canyon, Fresno County, California.

only 3 or, at most, 4 pairs which are recognizable when counted forward from anal lobes. Anal lobe cerarius with 2 small, slender, conical cerarian spines, 4 or 5 slender auxiliary setae, and a few scattered trilocular pores; remaining cerarii with but 2 conical setae, these progressively smaller, more slender, and often more widely separated than anal lobe pair, no auxiliary setae, with scarcely any concentration of trilocular pores. Dorsal body setae all small and slender. Dorsum with a few oral rim tubular ducts, these arranged 3 to 6 in a single row across each abdominal segment, except the last, and scattered over the thoracic segments and head. Oral collar tubular ducts lacking. Trilocular pores distributed over entire dorsum. Anal ring of normal size for the genus, with its 6 setae about twice as long as greatest diameter of ring.

On ventral side, multilocular disk pores present in considerable numbers from apical to fourth abdominal segment, often with 1 or 2 of these near each posterior coxa, and absent on remainder of thorax and head. Oral collar tubular ducts present on abdomen, quite numerous along lateral areas and across most segments. Oral rim tubular ducts, of same size as on dorsum, represented in limited numbers submarginally on thorax and head; completely lacking on abdomen. Ventral body setae slender and generally longer than those of dorsum. Trilocular pores evenly distributed on venter.

Circulus present, extending across fold between fourth and fifth abdominal segments. Antennae average in size for genus, 7- to 8-segmented. Legs moderate in size; apical half of hind tibiae with clusters of translucent dots or pores; claw without denticle or tooth on plantar surface. Mouth parts moderately slender.

NOTES. This species appears to be closely related to *Chorizococcus aphyllonis* (Cockerell) (= *Spilococcus aphyllonis*), but differs in having fewer dorsal oral rim tubular ducts on abdomen, and lacking these structures ventrally on abdomen. *C. aphyllonis* shows a considerable number of dorsal oral rim tubulars on abdomen, and possesses ventral submarginal band of these structures on abdomen.

I take pleasure in naming this species after H. L. Wilson, who not only collected this mealybug, but also several others which have proved to be of considerable interest.

Chorizococcus yuccae McKenzie, new species

(Figure 3)

Suggested common name. *Yucca* mealybug.

Hosts and distribution. Type and paratype adult females of this species were collected on *Yucca* sp. (Liliaceae), Norwalk (in nursery),⁴ Los Angeles County, California, March 24, 1960, by J. C. Wood (Calif. State Dept. Agr. #60C31-22).

Type material. Holotype adult female (1 specimen on 1 slide) has been deposited in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento. A single paratype has been placed

⁴ According to H. J. Ryan, Agricultural Commissioner of Los Angeles County, California, the infested *Yucca* was originally a native plant collected at Kingman, Arizona. The single plant was apparently destroyed shortly after the mealybugs were found.

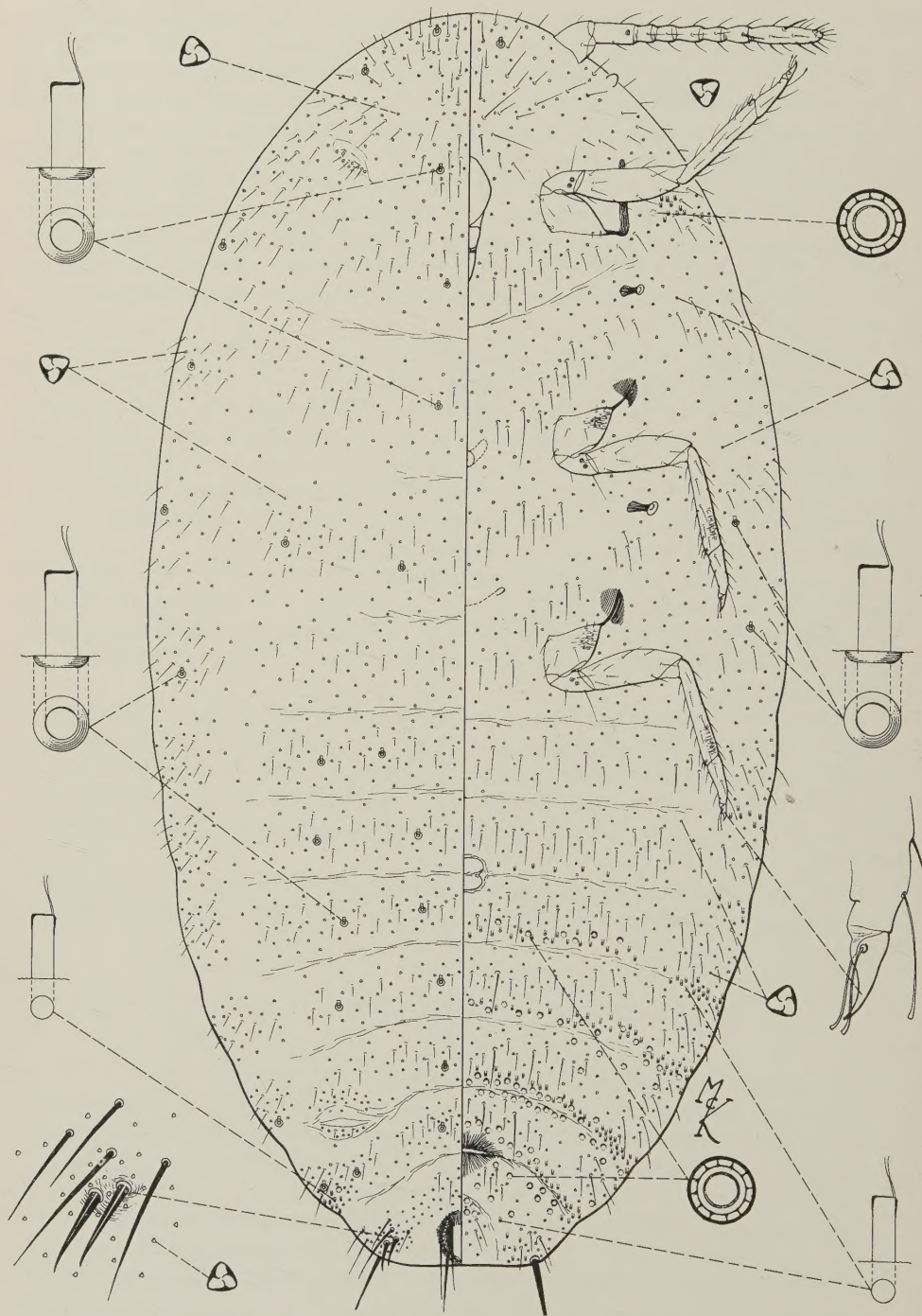


Fig. 3. *Chorisococcus yuccae* McKenzie, new species, collected on *Yucca* sp. (Liliaceae), Norwalk (in nursery), Los Angeles County, California.

in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. No information available, except that the species occurs above-ground and presumably feeds on leaves of its host.

Recognition characters. Length of largest available specimen approximately 2.60 mm. On dorsum cerarii represented by only anal lobe pair, these with but 2 rather elongate, partially conical, cerarian spines, accompanied by 3 or 4 noticeably long, slender, auxiliary setae of varying lengths, and a slight concentration of trilocular pores. Dorsal body setae all quite small and slender, those near lateral margins of abdominal segments possibly slightly longer. Dorsum with only few oral rim tubular ducts, these arranged in single row of 3 to 6 across each abdominal segment, except the last, and scattered over thoracic segments and head. Oral collar tubular ducts normally present along margin of abdomen on eighth and ninth segments. Trilocular pores distributed over entire dorsum. Anal ring of normal size for genus, with its setae about twice as long as greatest diameter of ring.

On ventral side, multilocular disk pores present in considerable numbers from apical to fifth abdominal segments; one of these structures near anterior coxa seems quite constant. Oral collar tubular ducts present on abdomen, quite numerous along lateral areas and across most of segments. Oral rim tubular ducts, same size as those on dorsum, represented in limited numbers along body margin between middle and hind legs; normally two of these present on head; completely lacking on abdomen. Ventral body setae slender, generally longer than those of dorsum. Trilocular pores numerous and generally distributed on venter.

Circulus present, extending across fold between fourth and fifth abdominal segments. Antennae average in size for genus, normally 8-segmented. Legs moderate in size; middle and hind coxae with cluster of translucent pores at base; apical half of hind tibiae with similar type pores; and claw without denticle or tooth on plantar surface. Mouth parts short though moderately slender.

NOTES. In the character of the elongate cerarian spines and auxiliary setae in the anal lobe cerarius, and the general shape of the segmentally divided circulus, this species is similar to *Chorizococcus reducta* (Ferris). It differs, however, mainly in possessing oral rim tubular ducts on the dorsum. These structures are absent in *reducta*.

Genus *Discococcus* Ferris

Ferris (1953)⁵ included 5 species in *Discococcus*, and indicated that the genus is entirely North American. One more species is here added to the group, and the key previously given by Ferris is revised to include it. To the genus there are now assigned 6 species for North America, 5 of which occur in California.

Key to *Discococcus* Species of North America

1. Anal ring definitely with pores..... 2
- Anal ring definitely without pores..... 3

⁵ Ferris, G. F. *Atlas of the Scale Insects of North America*. Ser. V-VI, *The Pseudococcidae*, I-II. Stanford Univ. Press, Stanford University, California, 1950-53. Illus.

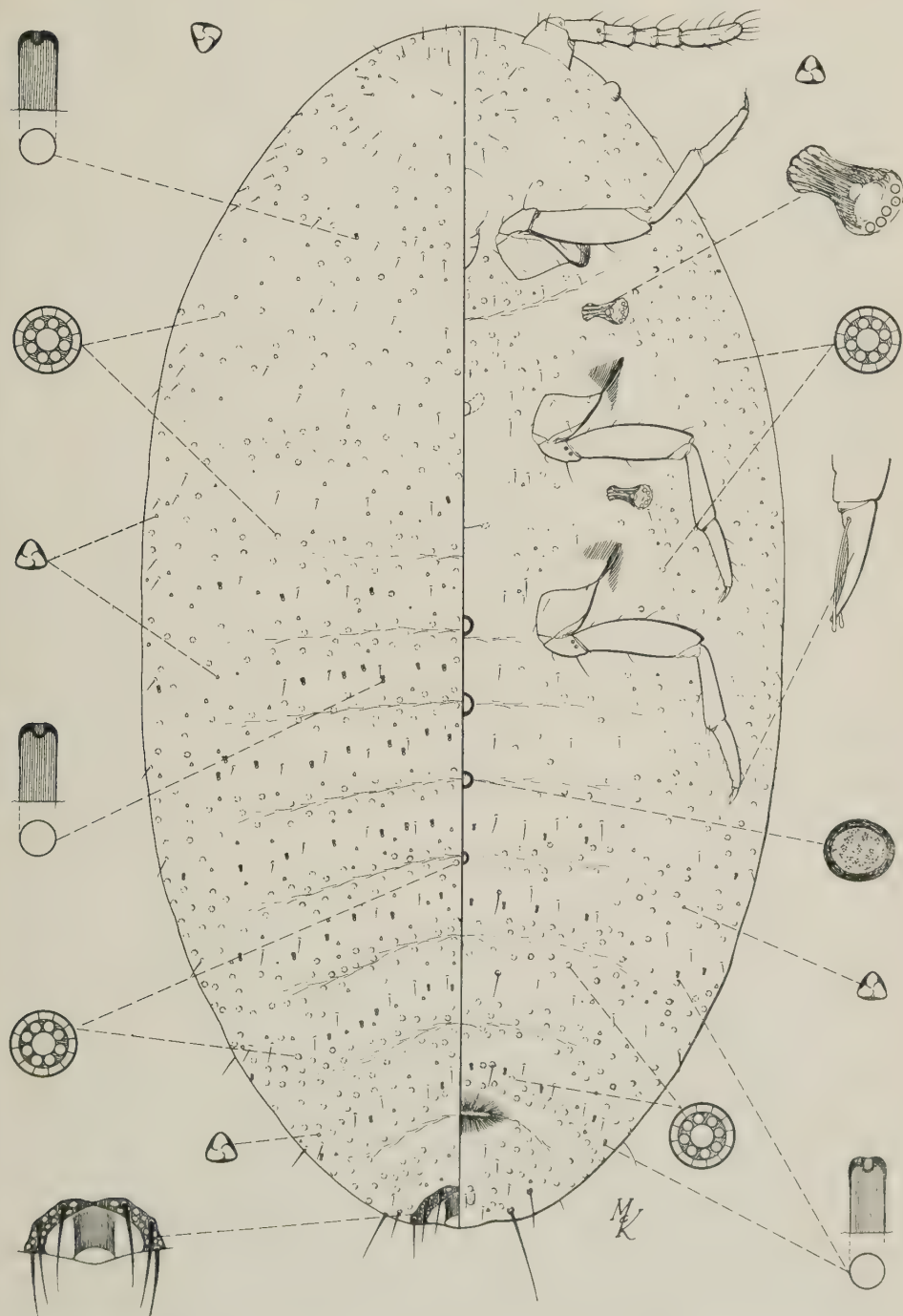


Fig. 4. *Discococcus spectabilis* McKenzie, new species, collected in soil beneath *Juniperus* sp. (Pinaceae), 1 mile north Cajon Pass, San Bernardino County, California.

5 or 6 pores in peritremes of spiracles instead of only 2, and more numerous dorsal multilocular disk pores in thoracic area. These characters preclude confusion with *hopi*. It is suspected that *spectabilis*, like *hopi*, occurs around the crowns or on the roots of a grass.

Heliococcus adenostomae McKenzie

Additional specimens (2 adult females and several nymphs) of this mealybug were recently beaten from branches of *Adenostoma fasciculatum* at Mix Canyon, southwest of Winters, Solano County, California, August 25, 1960, by R. O. Schuster.

Genus *Phenacoccus* Cockerell

Two new species of *Phenacoccus* are here added to those recorded by the author in the first publication of this series. The additions require some modification of the key presented earlier. To the genus there are now assigned 26 species for North America, 17 of which occur in California.

Key to *Phenacoccus* Species of North America

1. With more than 1 circulus..... 2
- With but 1 circulus or none..... 3
- 2 (1). Abdominal cerarii consisting of clusters of numerous conical setae.....*dearnessi* King
- Abdominal cerarii for most part with but 2 conical setae.....*aceris* Signoret
- 3 (1). Multilocular disk pores absent..... 4
- Multilocular disk pores present at least on venter in region of vulva..... 5
- 4 (3). Anal lobe cerarii with 6 to 10 enlarged setae or spines, these about same size and borne in a sclerotized area; quinquelocular pores lacking ventrally on abdomen.....*eriogoni* Ferris
- Anal lobe cerarii with but 2 enlarged setae or spines; quinquelocular pores present ventrally on abdomen.....*lycii* Ferris
- 5 (3). Multilocular disk pores present on both dorsum and venter, at least on abdomen 6
- Multilocular disk pores confined to venter.....13
- 6 (5). Circulus lacking.....*artemisiae* Ehrhorn
- Circulus present..... 7
- 7 (6). Enlarged setae of the anal lobe cerarii 6 to 10, all uniform in size and borne in a more or less sclerotized area.....*helianthi* (Cockerell)
- Enlarged setae of anal lobe cerarii normally 2 of the same size, with 1 or more additional setae of various sizes present at times, these not borne in a sclerotized area..... 8
- 8 (7). At least 1 abdominal segment with a dorsal, median cerarius consisting of 2 to 3 enlarged setae and a few pores..... 9
- Abdominal segments all without such a dorsal cerarius.....11
- 9 (8). Dorsum and the lateral margins of the body with numerous multilocular disk pores as far forward as head; dorsum with very numerous small tubular ducts.....*acericola* King
- Dorsum and lateral areas of body with multilocular disk pores only as far forward as the mesothorax; tubular ducts very few and scattered.....10
- 10 (9). Dorsal body setae throughout of same shape and of approximately same size as those of cerarii; dorsal median cerarii present on all abdominal segments except ninth.....*flaveolus* (Cockerell)
- Dorsal body setae for most part distinctly smaller and more slender than those of cerarii; dorsal median cerarii present only on abdominal segments 7 and 8.....*franseriae* Ferris
- 11 (8). Circulus very narrowly and very strongly produced laterally, resembling so-called "ox yoke" of early pioneer days.....*gossypii* Townsend and Cockerell
- Circulus round or oval and but very slightly or not at all produced laterally....12

- 12 (11). With numerous dorsal multilocular disk pores present on all abdominal segments, except last, a few situated on thorax and head; circulus quite small, transversely oval, occurring on fourth abdominal segment, not divided by segmental line; as far as known occurring only on Gramineae. *graminosus* McKenzie
Dorsal multilocular disk pores occur for most part along posterior border of abdominal segments 6 and 7, absent on thorax and head; circulus noticeably large, usually slightly oval, occurs on segmental line between fourth and fifth abdominal segments *eremicus* Ferris
- 13 (5). Circulus present 14
Circulus absent 24
- 14 (13). Dorsum entirely without tubular ducts scattered over surface (strictly marginal ones ignored) 15
Dorsum with considerable number of tubular ducts scattered over surface. 19
- 15 (14). With 17 or 18 pairs of recognizable cerarii present 16
With 15 or less pairs of recognizable cerarii present. *echeveriae* McKenzie
- 16 (15). Multilocular disk pores extremely few, there being less than 20 and these confined to posterior margin of eighth abdominal segment immediately anterior to vulva and area posterior to vulva. *defectus* Ferris
Multilocular disk pores present in considerable numbers about vulva and forward at least to seventh segment 17
- 17 (16). With small but distinct sclerotized area surrounding base of each cerarius
rubivorous Cockerell
Without small sclerotized area surrounding base of each cerarius. 18
- 18 (17). Antennae normally 8-segmented; circulus normally very small and oval; multilocular disk pores occur forward to segment posterior to circulus. *solani* Ferris
Antennae normally 9-segmented; circulus normally larger, flaccid and subject to distortion, sometimes slightly produced laterally; multilocular disk pores usually confined to area immediately about vulva and to segment 7
solenopsis Tinsley
- 19 (14). Abdominal segments 7 to 8 each with a median, dorsal cerarius, the setae of which are nearly as large as those of lateral cerarii; dorsal tubular ducts especially abundant in lateral areas of abdominal segments 6 to 9. *capensis* Ferris
Abdominal segments without such dorsal median cerarii; dorsal tubular ducts not thus concentrated along margins of abdominal segments. 20
- 20 (19). Many of dorsal body setae as stout and as long as, or longer than, those of lateral cerarii *celtisifoliae* Hollinger
Dorsal body setae noticeably more slender and shorter than those of lateral cerarii 21
- 21 (20). With 17 or 18 recognizable pairs of cerarii present. 22
With 15 or less recognizable pairs of cerarii present. 23
- 22 (21). Hind tibiae straight-sided, relatively slender and without or with very few translucent dots or pores, ventral quinquelocular pores present in considerable numbers from sixth abdominal segment anterior to and including sternal areas; circulus relatively large and flaccid. *tibiaeagracilis* McKenzie
Hind tibiae definitely swollen, with fairly numerous but not densely clustered translucent dots or pores; quinquelocular pores few and inconspicuous, occur principally in head region; circulus quite small and oval. *colemani* Ehrhorn
- 23 (21). Ventr I quinquelocular pores present on head and thorax; antennae 9-segmented
minimus Tinsley
Ventral quinquelocular pores absent on head and thorax; antennae 8-segmented
dicoriae McKenzie
- 24 (13). With 18 pairs of recognizable cerarii on dorsum; venter with scarcely more than 10 multilocular disk pores, these situated immediately anterior to vulva
pauperatus Ferris
Cerarian pairs reduced, there being normally only 3 to 5 pairs that are recognizable when counted forward from anal lobes; ventral multilocular disk pores present on ninth to usually fifth abdominal segments. 25

- 25 (24). Antennae 7- to 8-segmented; dorsal oral collar tubular ducts absent on abdomen; occur only on *Lotus* as far as known.....*lotearum* McKenzie
 Antennae normally 9-segmented; with at least a few dorsal oral collar tubular ducts present on abdomen; as far as known occurring only on *Eschscholtzia*
eschscholtziae McKenzie

Phenacoccus dicoriae McKenzie, new species

(Figure 5)

Suggested common name. Dicoria mealybug.

Hosts and distribution. The type and paratypes were collected on *Dicoria canescens* (Compositae), 3 miles west of Garnet, Riverside County, California, February 5, 1960, by S. W. Brown and Uzi Nur. This collection represents the only known examples of this species.

Type material. Holotype adult female (1 specimen mounted on 1 slide), and paratypes have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis. Paratypes have also been placed in the United States National Collection of Coccoidea at Washington, D.C., and in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento.

Habit. Apparently occurs aboveground on leaves and stems of the host. No other information available.

Recognition characters. Length of largest available specimen approximately 4.80 mm; noted range 3.00 mm to 4.80 mm. On dorsum 11 to 15 recognizable pairs of cerarii present, each normally with but 2 cerarian spines or setae, these generally quite small, often rather widely separated, especially those anterior to last 3 or 4 pairs, all without accompanying auxiliary setae and with very slight concentration of trilocular pores. Cerarii along mid-region of body in some specimens so inconspicuous that they are difficult to find. Dorsal body setae sparse, all small, slender. Trilocular pores abundant, evenly disposed over entire dorsum. Oral collar tubular ducts quite numerous, particularly in lateral areas of abdomen, arranged segmentally on most abdominal segments, also situated submarginally on meso- and metathorax. Anal ring of normal form and size for genus, with 6 enlarged setae, these about twice as long as greatest diameter of ring.

On venter, multilocular disk pores are abundant, especially in mid-region of abdomen, from apical to fourth segments; these structures lacking on thorax and head. Quinquelocular pores entirely lacking on body. Oral collar tubular ducts, with very slight oral collar, occur in considerable numbers in median and lateral areas of abdominal segments, and a few such ducts appear in thoracic region. Ventral body setae slender, considerably longer than those on dorsum. Trilocular pores fairly numerous, evenly distributed on venter.

Circulus moderately large, oval. Antennae moderately long, normally 8-segmented. Legs proportionately well-developed; claws with prominent denticle or tooth on plantar surface. Mouth parts relatively slender.

NOTES. This mealybug appears to resemble, at least to some degree, *Phenacoccus minimus* Tinsley, but differs from it in lacking ventral quinquelocular pores on thorax and head. These structures are definitely present in species just mentioned. Other differences include an 8-segmented antenna and a greater number of ventral multilocular disk pores in *dicoriae*, as com-

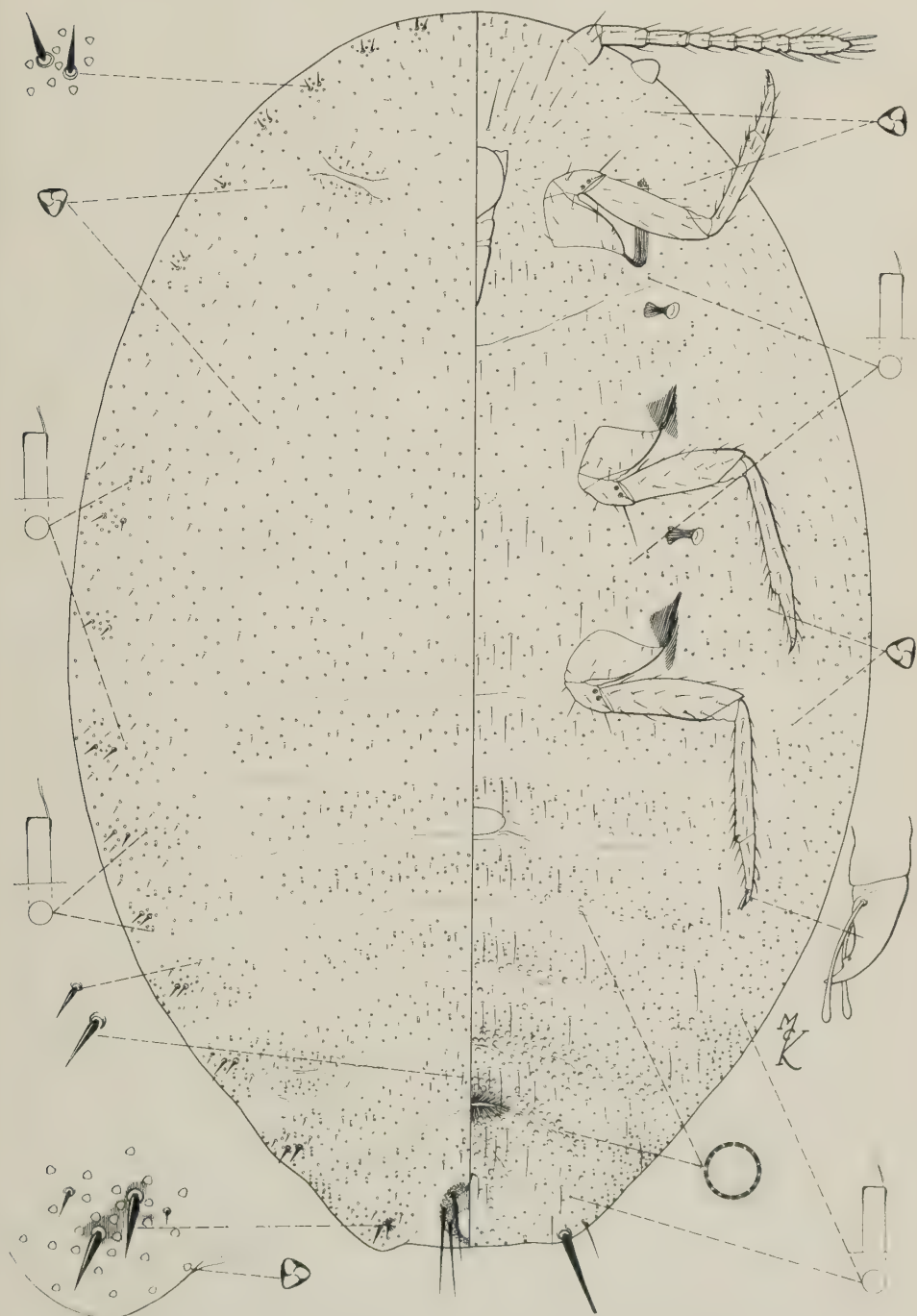


Fig. 5. *Phenacoccus dicoriae* McKenzie, new species, collected on *Dicoria canescens* (Compositae), 3 miles west of Garnet, Riverside County, California.

pared with a 9-segmented antenna and fewer ventral multilocular disk pores in *minimus*.

***Phenacoccus eschscholtziae* McKenzie, new species**
(Figure 6)

Suggested common name. California poppy mealybug.

Hosts and distribution. Type and paratypes of this species were collected on *Eschscholtzia* sp. (Papaveraceae), Box Springs Canyon, near Shavers Well, Riverside County, California, April 14, 1935, by J. D. Maple. This collection represents the only known material concerning this mealybug.

Type material. Holotype adult female and single paratype of the same sex have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. No available information.

Recognition characters. Length of adult female approximately 3.50 mm. On dorsum only 3 or 4 recognizable pairs of abdominal cerarii present, each normally with only 2 cerarian spines or setae, these generally very small and slender, often widely separated, especially those anterior to antepenultimate pair, all without accompanying auxiliary setae, but with a very slight concentration of trilocular pores. Dorsal body setae relatively sparse, all small and slender. Trilocular pores evenly beset over entire dorsum. Oral collar tubular ducts sparsely distributed, scattered on abdominal segments, apparently lacking on thorax, 1 or 2 situated in head area. Anal ring of normal form and size for genus, with 6 enlarged setae, these about twice as long as greatest diameter of ring.

On venter, multilocular disk pores in cluster about vulva; a few such pores (mostly in mid-region) also forward to segment 5; these structures lacking on thorax and head. Quinelocular pores entirely lacking on body. Oral collar tubular ducts occur in considerable numbers in median and lateral areas of abdomen; a few such ducts appear in thoracic regions. Ventral body setae slender and considerably longer than on dorsum. Trilocular pores fairly numerous, evenly distributed on venter.

Circulus lacking. Antennae moderately long, normally 9-segmented. Legs proportionately well-developed; tibiae with numerous dots or pores; claws with a prominent denticle or tooth on plantar surface. Mouth parts relatively slender.

NOTES. This mealybug resembles, at least to some degree, *Phenacoccus lotearum* McKenzie, but differs in having a 9-segmented antenna, dorsal oral collar tubular ducts, more slender legs, fewer discernible cerarii, and a very different host. *P. lotearum*, on the other hand, possesses an 8-segmented antenna, lacks dorsal oral collar ducts, has stouter, more robust legs, has 5 cerarian pairs on abdomen instead of only 3 or 4, and apparently is restricted to *Lotus*. *P. eschscholtziae* is also similar to *P. pauperatus* Ferris, but presence of numerous ventral multilocular disk pores, particularly posterior to vulva, precludes confusion with the latter form.

***Phenacoccus graminosus* McKenzie**

Specimens of this species were found infesting wild oat, *Avena fatua* (Gramineae), at Greenbrae, Marin County, California, April 2, 1960, by T. R. Haig (Calif. State Dept. Agr. #60D29-158).

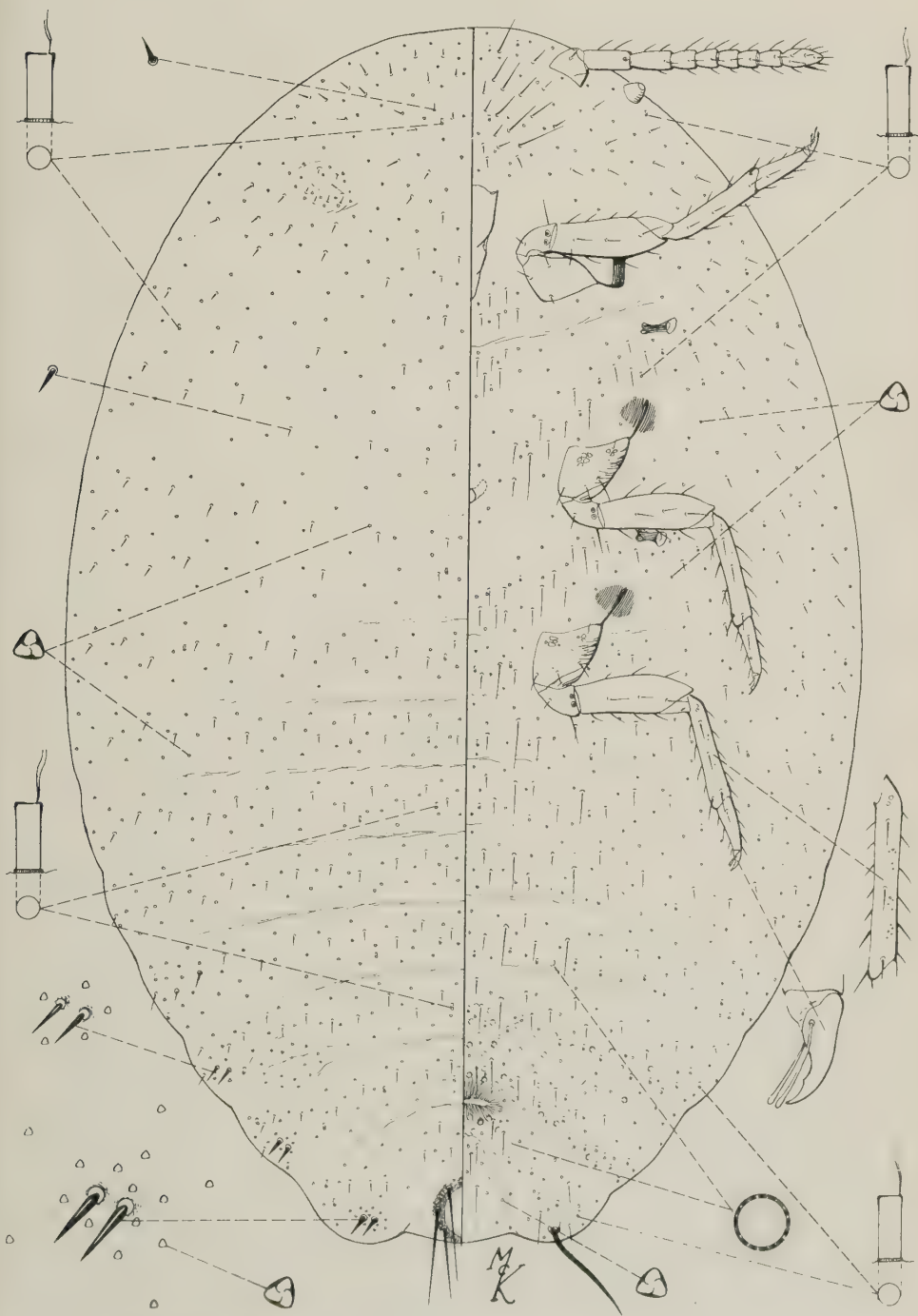


Fig. 6. *Phenacoccus eschscholtziae* McKenzie, new species, collected on *Eschscholtzia* sp. (Papaveraceae), Box Springs Canyon, near Shavers Well, Riverside County, California.

Pseudococcus microcirculus McKenzie

Specimens of this mealybug were recently found established on orchid in a nursery at San Gabriel, Los Angeles County, California, September 27, 1960, by W. Edwards and L. R. Gillogly (Calif. State Dept. Agr. #60J20-2).

Genus *Puto* Signoret

Four new California species of *Puto* were described in the first publication of this series. To these are now added 4 additional forms, and the key is revised to include them. To the genus there are now assigned 18 species for North America, 12 of which occur in California.

Key to *Puto* Species of North America

1. Ventral multilocular disk pores present on last 2 abdominal segments..... 2
 Ventral multilocular disk pores absent on last 2 abdominal segments
 nulliporus McKenzie
- 2 (1). Circulus present 3
 Circulus absent *acirculus* McKenzie
- 3 (2). With at least 3 to 4, usually more, ventral multilocular disk pores present anterior to mid and hind coxae, normally present in head region..... 6
 Ventral multilocular disk pores normally lacking anterior to mid and hind coxae, except for perhaps 1 or 2 near spiracles, absent in head region..... 4
- 4 (3). Cerarian plates with enlarged tubular ducts; ventral multilocular disk pores present on seventh abdominal segment 5
 Cerarian plates without enlarged tubular ducts; ventral multilocular disk pores absent on seventh abdominal segment; as far as known occurring only on *Pseudotsuga taxifolia* *profusus* McKenzie
- 5 (4). Dorsum with numerous lanceolate setae, many of which are borne upon a well-developed basal sclerosis; ventral multilocular disk pores present on fifth and sixth abdominal segments; as far as known occurring only on *Batis echinatus* McKenzie
- No dorsal setae with sclerotized bases; ventral multilocular disk pores lacking on fifth and sixth abdominal segments; as far as known occurring only on *Simmondsia chinensis* *simmondsiac* McKenzie
- 6 (3). Circulus partially or even completely divided medially by a constriction; a Central American species at present known from orchids..... *ulter* Ferris
- 7 (6). Circulus with no trace of such a median constriction..... 7
 Compact clusters of ventral submarginal multilocular disk pores present on each abdominal segment; occur in bark cracks and crevices of *Pinus ponderosa* and *P. jeffreyi*, as far as known *latieribellum* McKenzie
- Compact clusters of ventral submarginal multilocular disk pores not present on each abdominal segment 8
- 8 (7). Dorsum with tubular ducts in addition to those in or around cerarian plates; antennae normally 8-segmented, although at times 9-segmented; anal ring frequently with 8 or more enlarged setae; occurs on conifers as far as known *cupressi* (Coleman)
- Dorsum entirely without tubular ducts other than those which may occur in immediate vicinity of the cerarian plates; antennae normally 9-segmented; anal ring normally with 6 enlarged setae..... 9
- 9 (8). Cerarian plates without enlarged tubular ducts, and not accompanied by such ducts, except for occasionally 1 or 2 ducts on terminal plates..... 10
 Cerarian plates for most part with enlarged tubular ducts..... 15

- 10 (9). Dorsum with great numbers of lanceolate setae, each of which arises from a well-developed basal sclerosis, these scleroses at times coalesce to form little, irregular plates; as far as known occurs only on grasses. *calcitectus* (Cockerell)
Dorsum without enlarged sclerotic setal bases, the setal tubercles, for most part, quite small 11
- 11 (10). Circulus small, broadly oval on its transverse axis; a species at present known only from high altitudes in California. *bryanthi* Ferris
Circulus elongate on its transverse axis. 12
- 12 (11). With 13 to 22 enlarged setae or spines on anal lobe cerarius. 13
With 28 to 38, or perhaps even more, enlarged setae or spines on anal lobe cerarius 14
- 13 (12). Normally with 7 to 10 ventral multilocular disk pores on seventh abdominal segment; legs short and stout, proportionately smaller than usual for genus, not projecting beyond seventh segment at full maturity; as far as known occurring only on *Atriplex* *atriplicis* McKenzie
Normally with only 1 to 3 ventral multilocular disk pores on seventh abdominal segment; legs long and slender, normally project beyond eighth or ninth abdominal segment; a species known only from high altitudes in California
pricei McKenzie
- 14 (12). Dorsal body setae rather sparse, arranged for most part in patches or interrupted rows; a species with a wingless male, known at present only from the Pacific Coast *ambigua* (Fullaway)
Dorsal body setae very numerous, not thus occurring in separate patches and interrupted rows; a tropical species at present known from West Indies
barberi (Cockerell)
- 15 (9). Cerarian plates all extremely large, more or less rectangular in form; at present known only from *Arctostaphylos* in California. *arctostaphyli* Ferris
Cerarian plates only moderately large, circular or oval. 16
- 16 (15). Cerarian plates usually including 2 tubular ducts, occasionally with 3, rarely with more *yuccae* (Coquillett)
Cerarian plates with not less than 4 tubular ducts, frequently with many more. . . 17
- 17 (16). Dorsal body setae as large as those of cerarii, arranged in discrete patches over body with bare areas between patches, these patches especially evident along mid-line of abdominal dorsum. *lasiotum* (Cockerell)
Dorsal body setae smaller than cerarian setae, scattered, not arranged in discrete patches *mexicanus* (Cockerell)

Puto atriplicis McKenzie, new species

(Figure 7)

Suggested common name. A triplex puto mealybug.

Hosts and distribution. Type and paratype adult females of this new mealybug species were collected on *Atriplex* sp. (Chenopodiaceae), Palm Springs, Riverside County, California, April 9, 1936, by J. D. Maple. This collection comprises the only known specimens of this mealybug.

Type material. Holotype adult female (1 specimen mounted on 1 slide), and paratypes of this species have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. No available information. It is assumed the mealybug occurs aboveground on the leaves or on the stems of its host.

Recognition characters. Adult female broadly oval, ranging in length from 4.00 mm to 4.75 mm. On dorsum the cerarii appear basically in 18 pairs, this arrangement, however, interrupted by division of individual cerarii or by interpolation of others; each cerarius formed upon a sclerotized plate bearing 6 to 22, or perhaps more, enlarged conical spines or setae, these spines apically pointed, slightly lanceolate, without tubular ducts, trilobular

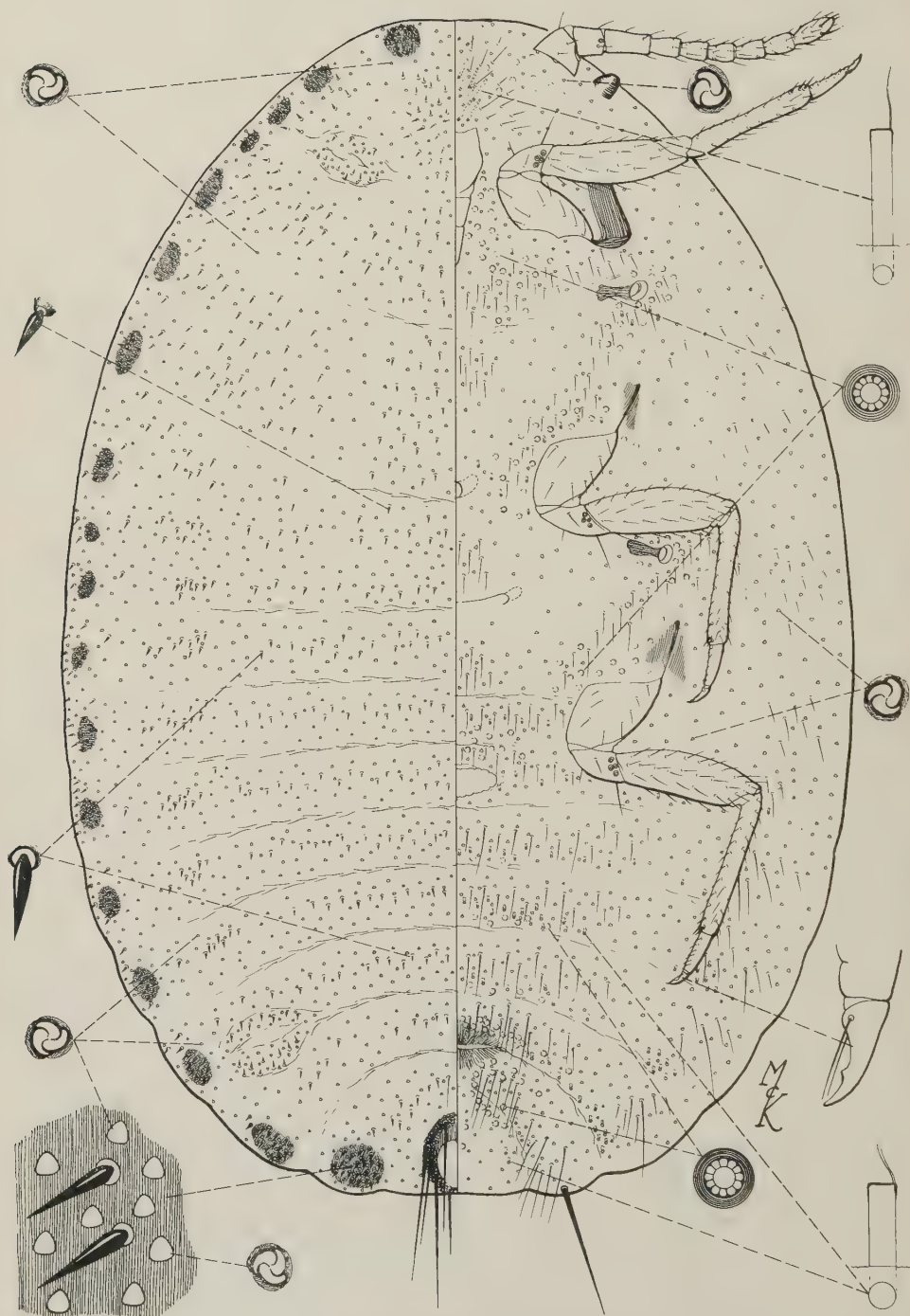


Fig. 7. *Puto atriplicis* McKenzie, new species, collected on *Atriplex* sp. (Chenopodiaceae), Palm Springs, Riverside County, California.

pores borne on cerarian plates usually somewhat more numerous than the conical spines. Tubular ducts of oral collar type, entirely lacking on dorsum. Dorsal body setae similar in form to those of cerarii, showing little or no tendency to be aggregated into groups, quite numerous, appear in transverse bands on the abdominal segments; scattered on thoracic segments and head. Trilocular pores uniformly distributed over entire dorsum. Anal ring with usually 6 enlarged setae, or numbers of these may be increased by smaller supernumerary setae, the total number of 8 being most common. Certain specimens are available, however, which exhibit as many as 10 or more of these spines.

Ventral multilocular disk pores of two slightly different sizes are present, the smaller ones occurring on anterior portion of abdomen and on thorax and head; these pores occur on all abdominal segments, especially in mid-region of abdomen; and they are abundant on thorax and head. Tubular ducts of oral collar type fairly numerous in transverse bands on abdominal segments, also in small clusters submarginally from apical to seventh segments; limited numbers of these structures present on thorax, and a few more slender and elongate ones situated in the cephalic region just anterior to mouth parts. Trilocular pores generally distributed over venter with the exception of certain "clear areas" on sternal region where they appear less numerous. Ventral setae long and slender.

Circulus present, broad, transversely oval, with margins appearing somewhat crenulated. Antennae long and slender, normally 9-segmented. Legs proportionately smaller than usual for this genus; claws exhibiting a well-developed denticle or tooth on plantar surface.

NOTES. This new species is similar to *Puto pricei* McKenzie, but differs chiefly in possessing many more ventral multilocular disk pores on abdominal segments 4, 6, and 7, more obvious clusters of ventral oral collar ducts on last 3 or 4 abdominal segments, and proportionately smaller legs. *Puto pricei*, on the other hand, entirely lacks, or has only 1 to 3 ventral multilocular disk pores on abdominal segments 4 and 7, and possesses only 3 or 4 such pores on segment 6, lacks actual clusters of ventral oral collar ducts on last 3 or 4 abdominal segments, and has proportionately longer and more slender legs.

Puto echinatus McKenzie, new species

(Figure 8)

Suggested common name. Batis mealybug.

Hosts and distribution. Holotype adult female of this species was collected on *Batis* sp. (Batidaceae), Malibu, Los Angeles County, California, May 17, 1960, by A. G. C. Beresford and G. G. Beevor (Calif. State Dept. Agr. #60E31-1). This female represents the only known specimen of this mealybug.

Type material. Holotype adult female (1 specimen mounted on 1 slide), has been deposited in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento.

Habit. No available information.

Recognition characters. Adult female broadly oval, approximately 3.50 mm long. Cerarii appear basically in 18 pairs on dorsum, this arrangement,

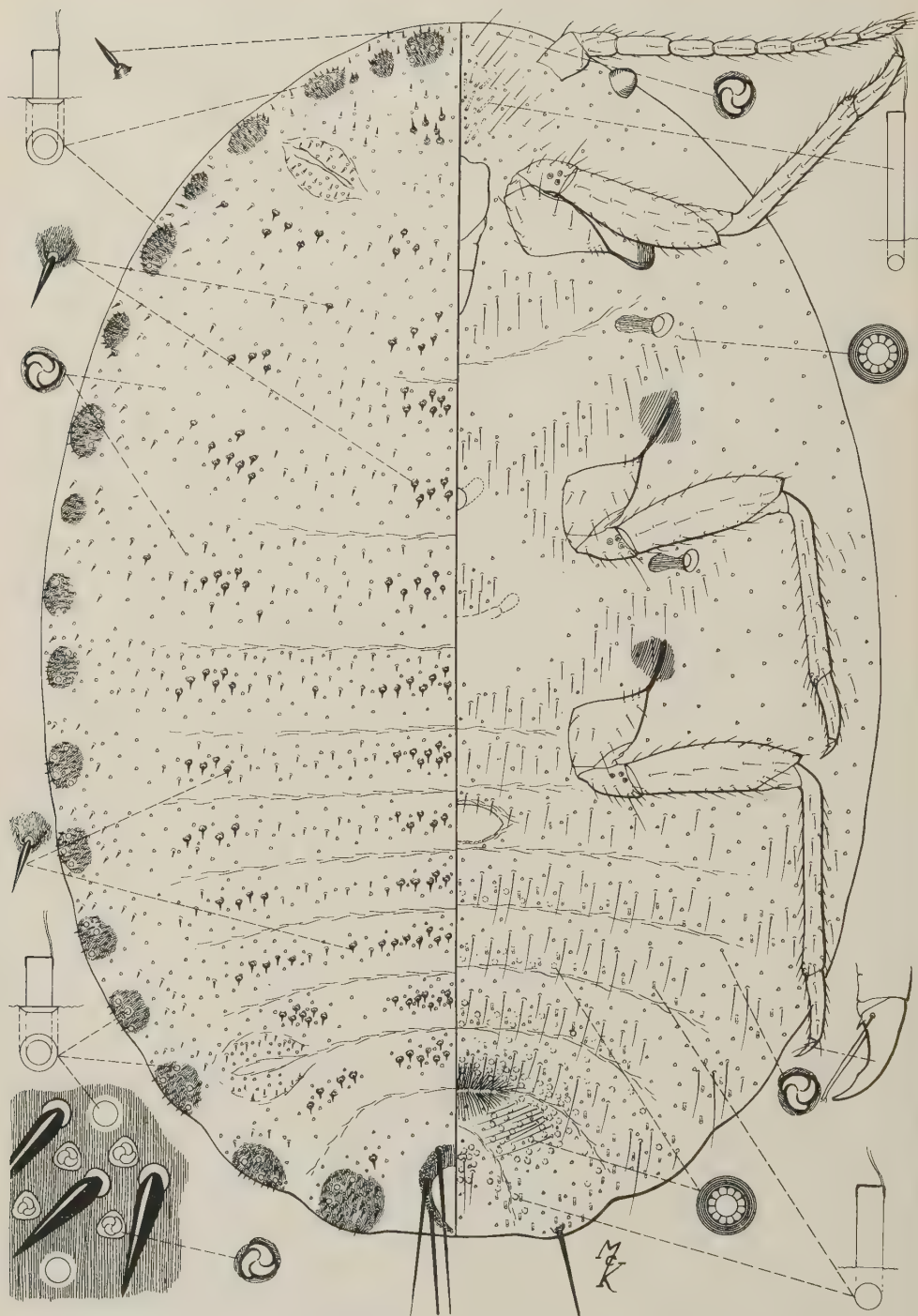


Fig. 8. *Puto echinatus* McKenzie, new species, collected on *Batis* sp. (Batidaceae), Malibu, Los Angeles County, California.

however, interrupted by division of individual cerarii or by interpolation of others, each cerarius formed upon a sclerotized plate bearing 8 to 26, or perhaps even more, enlarged conical spines or setae, these setae apically pointed and slightly lanceolate; most cerarian plates possess 2 to 4 enlarged tubular ducts; trilocular pores on cerarian plates usually about as numerous as conical spines, sometimes more so. Dorsal body setae, similar in form to those of cerarii, numerous, arranged in transverse bands on the abdominal segments, and cover the thoracic segments and head. Many of these setae are borne upon a well-developed basal sclerosis. Trilocular pores distributed over entire dorsum. Anal ring normally with 6 large, elongate setae.

On ventral side of body, multilocular disk pores present, especially in mid-region of the abdomen, from apical to fifth segments, lacking on thorax except for possibly 1 or 2 near anterior spiracles, apparently lacking on head. Tubular ducts of oral collar type present in limited numbers on most abdominal segments, a few more slender, elongate ones situated in cephalic region just anterior to mouth parts. Trilocular pores sparingly distributed over venter with exception of certain "clear areas" in sternal region where they appear to be entirely lacking.

Circulus present, quite small for members of this group, broadly oval, with margins somewhat crenulated. Antennae long, slender, normally 9-segmented. Legs large, slender; claws exhibit a weakly developed denticle or tooth on plantar surface.

NOTES. This new mealybug is similar to *Puto simmondsiae* McKenzie n.sp., but differs in possessing many dorsal body setae which are borne upon well-developed basal scleroses, and ventral multilocular disk pores on fifth and sixth abdominal segments. *P. simmondsiae* lacks basal scleroses on any of the dorsal setae, and also lacks ventral multilocular disk pores on fifth and sixth abdominal segments. *P. echinatus* has some affinities with *P. yuccae* (Coquillett), although the almost total absence of ventral multiloculars on thorax and head precludes confusion with the latter form which has an abundance of these pores in this area.

Puto laticribellum McKenzie, new species

(Figure 9)

Suggested common name. Pine bark mealybug.

Hosts and distribution. Type and paratype adult females of this species were collected on *Pinus ponderosa* (Pinaceae), 5 miles north of Old Station, Shasta County, California, May 28, 1960, by H. H. Keifer (Calif. State Dept. Agr. #60E31-57). Additional paratypes of this species are at hand as follows: on *Pinus jeffreyi*, Lassen National Park, Shasta County, California, June 19, 1935, W. H. Lange, collector, and on *Pinus ponderosa*, Yosemite National Park, Miguel Meadow, Mariposa County, California, July 10, 1938, E. O. Essig, collector.

Type material. Holotype adult female (1 specimen mounted on 1 slide), has been deposited in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento; and paratypes have been placed in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. Occurs in the cracks of bark on main tree trunk.

Recognition characters. Adult female broadly oval, reaching length of 5 or 6 mm. On dorsum the cerarii appear basically in 18 pairs, this arrangement, however, interrupted by division of individual cerarii or by interpolation of others, each cerarius formed upon a sclerotized plate bearing 3 to 17, or perhaps more, enlarged conical spines or setae, these spines apically pointed, slightly lanceolate; each abdominal cerarian plate with 0 to 4 tubular ducts, these apparently absent on thoracic cerarian plates; trilocular pores on cerarian plates usually somewhat more numerous than conical spines. Tubular ducts, of type represented within cerarian plates, sparingly distributed on abdomen, mostly submarginal. Dorsal body setae, similar in form to those of cerarii, fairly numerous, arranged in transverse bands on abdominal segments, covering thoracic segments and head. Trilocular pores distributed over entire dorsum. Anal ring with normally 8 long, stout and elongate setae or spines.

On ventral side of body, multilocular disk pores present in considerable numbers in mid-region, especially so submarginally on all abdominal segments, except the last, where they appear in dense clusters (whence the specific name was derived), these pores also distributed in sternal areas, and in dense clusters between spiracles and body margin, a few present on head. Tubular ducts of oral collar type present on venter of abdominal segments, more numerous in submarginal areas, a few more slender, elongate ones situated in cephalic region just anterior to mouth parts. Trilocular pores sparingly distributed over venter. Ventral setae long, slender.

Circulus broad, transversely oval, with margin somewhat crenulated. Antennae long, slender, normally 8-segmented. Legs proportionately smaller than usual for genus; coxae exhibit a characteristic area of reticulation; claws with a well-developed denticle or tooth on plantar surface.

NOTES. The conspicuous clusters of ventral submarginal multilocular disk pores on abdomen and near spiracles immediately set this new species apart from all other North American *Puto*. In the character of cerarian plates enclosing tubular ducts the new form approaches *Puto yuccae* (Coquillett).

Puto pricei McKenzie

Additional specimens of this mealybug, preserved in alcohol, have been found in the California Academy of Sciences collection. These were labeled as taken on *Pinus albicaulis* (Pinaceae), Mt. Goethe (12,000'), Fresno County, California, July 9, 1952, by Peter Raven.

Puto simmondsiae McKenzie, new species (Figure 10)

Suggested common name. Simmondsia mealybug.

Hosts and distribution. Type and paratype adult females of this mealybug were collected on *Simmondsia chinensis* (Buxaceae), Indio, Riverside County, California, September 9, 1935, by H. L. McKenzie. A single adult female, just molting and within skin of previous stage, has become available, that for the present may be placed with this species, collected on leaves of *Simmondsia chinensis* on cliffs along edge of bay, Guaymas, State of Sonora, Mexico, August 17, 1959, by F. C. Raney and D. C. Finfrook.

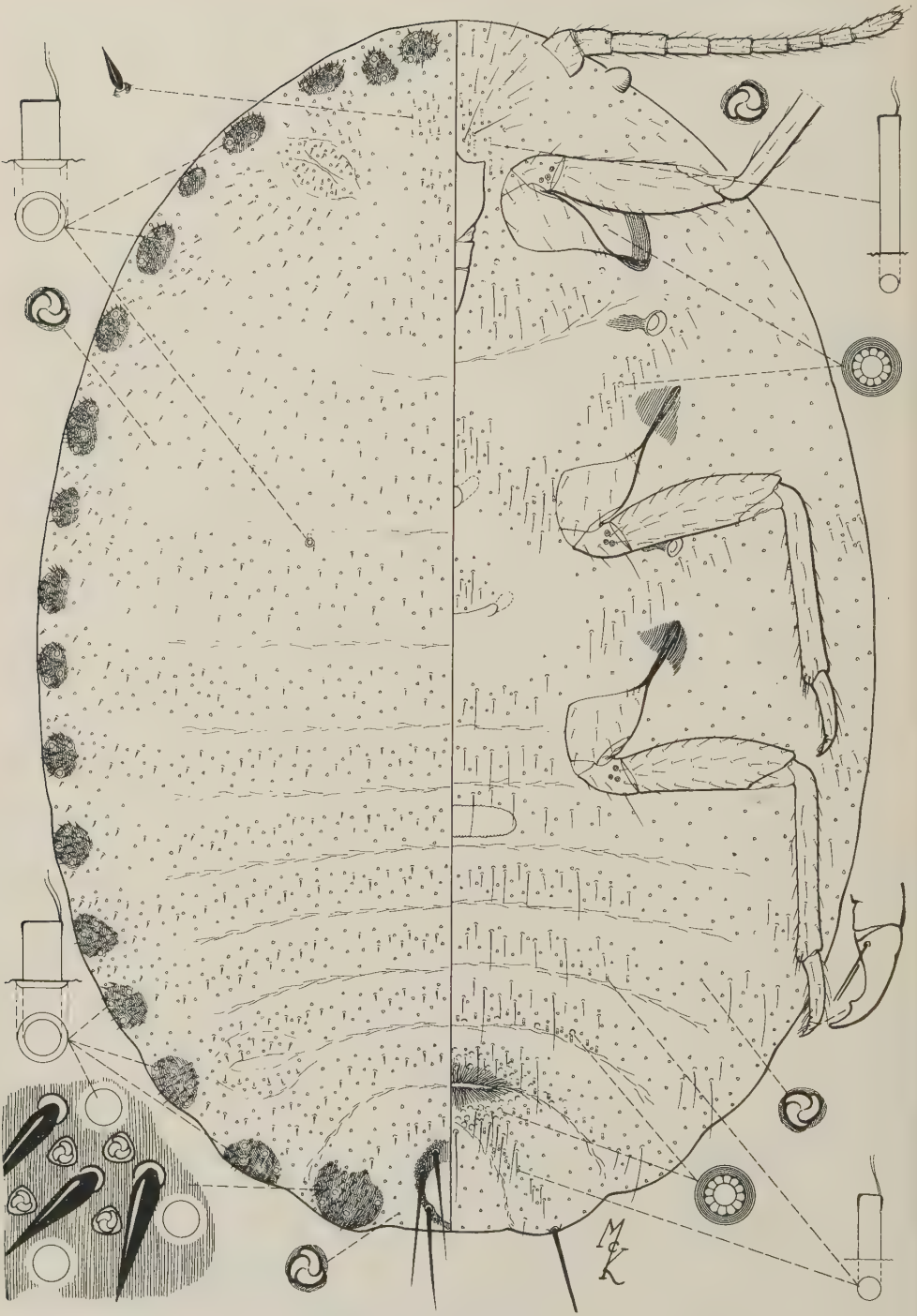


Fig. 10. *Puto simmondsiae* McKenzie, new species, collected on *Simmondsia chinensis* (Buxaceae), Indio, Riverside County, California.

Type material. Holotype adult female (1 specimen mounted on 1 slide), and a single paratype specimen have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. No available information, except that the mealybug occurs above-ground on the leaves and stems of its host.

Recognition characters. Adult female broadly oval, approximately 3.50 mm long. On dorsum the cerarii appear basically in 18 pairs, this arrangement, however, interrupted by division of individual cerarii or by interpolation of others; each cerarius formed upon a sclerotized plate bearing 11 to 28, or perhaps more, enlarged conical spines or setae, these spines apically pointed, slightly lanceolate; each cerarian plate with 2 to 5 tubular ducts, these possibly somewhat variable in size; trilocular pores borne on cerarian plates usually somewhat more numerous than conical spines. Tubular ducts, of type represented within cerarian plates, sparingly distributed on thorax. Dorsal body setae, similar in form to those of cerarii, numerous and arranged in transverse bands on the abdominal segments and covering the thoracic segments and head. Trilocular pores distributed over entire dorsum. Anal ring with normally 6 large and elongate setae.

On ventral side of body, multilocular disk pores present, especially near mid-ventral line, on last 3 abdominal segments; sparsely distributed near spiracles, front coxae, and mouth parts, apparently lacking on head. Tubular ducts of oral collar type present in limited numbers on venter of abdominal segments, and a few more slender, elongate ones situated in cephalic region just anterior to mouth parts. Trilocular pores sparingly distributed over venter with exception of certain "clear areas" in sternal region where they appear to be entirely absent.

Circulus broad, transversely oval, with margins appearing somewhat crenulated. Antennae long, slender, normally 9-segmented. Legs unusually large, slender; claws exhibit a well-developed denticle or tooth on plantar surface.

NOTES. This species is similar to *Puto yuccae* (Coquillett) particularly in restricted number of tubular ducts on cerarian plates. It differs from *yuccae*, however, in lacking ventral multilocular disk pores on abdomen anterior to sixth segment, and far fewer of these structures on thorax, none on head. *Puto yuccae*, on the other hand, possesses numerous ventral multiloculars on all abdominal segments, thorax, and head.

Genus *Rhizoecus* Künckel d'Herculaïs

Two more California species are here added to the genus. This requires a complete recasting of the key previously given. To the genus there are now assigned 23 species for North America, 15 of which occur in California.

Key to *Rhizoecus* Species of North America

- | | | |
|--------|--|----|
| 1. | Without circulus | 14 |
| | With at least 1 circulus | 2 |
| 2 (1). | Tritubular pores definitely present, although at times quite small and inconspicuous | 3 |
| | Tritubular pores definitely absent | 8 |

- 3 (2). Antennae 5-segmented *californicus* Ferris 4
 Antennae 6-segmented 5
- 4 (3). Tubular ducts of oral collar type absent 5
 With at least a few tubular ducts of oral collar type present, both dorsally and ventrally, usually very small 6
- 5 (4). Multilocular disk pores absent ventrally on abdomen..... *leucosomus* (Cockerell)
 Multilocular disk pores present ventrally on abdomen..... *sonomae* McKenzie
- 6 (4). Multilocular disk pores absent ventrally on abdomen..... 7
 Multilocular disk pores present ventrally on abdomen..... *browni* McKenzie
- 7 (6). Digitules long and slender, setose, extending practically to tip of claw
cacticans (Hambleton)
 Digitules short, setose, not extending beyond middle of claw
maritimus (Cockerell)
- 8 (2). With 3 to 5 circuli..... *campestris* Hambleton
 With not more than 2 circuli 9
- 9 (8). Multilocular disk pores present ventrally on thorax.... *bituberculatus* McKenzie
 Multilocular disk pores absent on thorax venter..... 10
- 10 (9). With 2 circuli *kondonis* Kuwana
 With but 1 circulus 11
- 11 (10). Eighth abdominal segment with 35 to 50 multilocular disk pores on venter
spinosus McKenzie
 Eighth abdominal segment normally with less than 20 multilocular disk pores on venter 12
- 12 (11). Tarsal claws with digitules as long as or longer than claw itself, apically knobbed or swollen *gracilis* McKenzie
 Tarsal claws with digitules shorter than claw itself, apically acute..... 13
- 13 (12). Multilocular disk pores present on dorsum of eighth abdominal segment; with tubular ducts, joined as pairs, extending internally..... *solani* Hambleton
 Multilocular disk pores absent on dorsum of eighth abdominal segment; with very small bitubular-type pores, divaricating, and projecting externally
tonicopan Hambleton
- 14 (1). Dorsum of most abdominal segments with a transverse row of tritubular pores, these rows having 10 to 16 pores; antennae 5-segmented
falcifer Künckel d'Herculais
 Dorsum of abdominal segments with tritubular pores not thus arranged, or if rows can be detected they include not more than 6 to 7 pores..... 15
- 15 (14). Anal lobes terminate in a small but distinct area of sclerotization..... 16
 Anal lobes without such a sclerotization..... 17
- 16 (15). Inner row of pores of the anal ring clouded..... *associatus* (Hambleton)
 Inner row of pores of the anal ring not clouded..... *distinctus* (Hambleton)
- 17 (15). Multilocular disk pores present only on venter of abdomen..... 18
 Multilocular disk pores—even if very few—present dorsally and ventrally..... 22
- 18 (17). Abdominal segments 6 and 7 ventrally each with a transverse row of small trilobular pores extending across median region *mayanus* (Hambleton)
 No abdominal segment with transverse row of trilobular pores in median region. 19
- 19 (18). Eyes absent *eluminatus* McKenzie
 Eyes present 20
- 20 (19). A very few small ventral tubular ducts present posterior to vulva..... 21
 Small ventral tubular ducts lacking anywhere on body..... *pritchardi* McKenzie
- 21 (20). Each anal lobe area with 2 elongate setae and 2 or 3 smaller auxiliary setae; 1 to 4 body setae associated with each tritubular pore..... *cyperalis* (Hambleton)
 Each anal lobe area with 3 elongate setae and 5 to 8 smaller auxiliary setae; body setae not associated with tritubular pores..... *nemoralis* (Hambleton)
- 22 (17). Dorsal multilocular disk pores form distinct rows on all segments from mesothorax to abdominal segment eight *graminis* (Hambleton)
 Dorsal multilocular disk pores very few and scattered, not in rows
americanus (Hambleton)

***Rhizoecus browni* McKenzie, new species**

(Figure 11)

Suggested common name. Brown mealybug.

Hosts and distribution. Holotype adult female collected in soil under *Juniperus* sp., 1 mile north Cajon Pass, San Bernardino County, California (Highway 66-395), February 5, 1960, S. W. Brown collector. A Berlese funnel was used to recover this mealybug from the soil. In addition to juniper, the soil from which this mealybug was taken supported two (2) other plant species, namely, *Sitanion hystrix* (Gramineae), and *Eriogonum fasciculatum* [ssp.] *polifolium* (Polygonaceae). It is suspected that this *Rhizoecus* was feeding on the roots of the *Sitanion* grass, although additional field evidence is needed to substantiate this. Recently, additional paratype specimens of this species were collected in soil under *Quercus wislizenii* (canopy), 5 miles northwest of Spanish Flat, Napa County, California, March 1, 1961, by H. L. McKenzie. The soil supported three plant species, a grass, *Stipa lepida* (Gramineae), *Claytonia lanceolata* (Portulacaceae), and *Dodecatheon hendersonii* (Primulaceae). It is suspected that this mealybug was feeding on the roots of the grass, although additional field evidence is needed to substantiate this suspicion.

Type material. Holotype adult female of this species mounted on 1 slide has been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis.

Habit. No information other than that the mealybug occurs in the ground where it presumably feeds on roots of a plant. It is suspected that the grass roots of *Sitanion hystrix* and *Stipa lepida* may be the hosts attacked by this mealybug.

Recognition characters. Length of single mounted adult female is approximately 1.00 mm. On dorsum cerarii are entirely lacking. Anal lobes with several slender setae of various lengths, these arising from slightly sclerotized area. Tritubular pores scattered over dorsum numerous, as many as 34 or 35 observed. Dorsum beset with trilocular pores and small body setae. A few small oral collar ducts present on certain abdominal segments. Multilocular disk pores present in small numbers along posterior margin of sixth and eighth abdominal segments. Anal ring at apex of abdomen, its 6 setae approximately twice as long as greatest diameter of ring; its pores large, oval and irregularly shaped, clear and open. Dorsal ostioles well-developed.

Ventrally, multilocular disk pores present in some numbers from apical to posterior margin of sixth abdominal segment, a few situated near middle and front coxae, several located near mouth parts. Tritubular pores few on abdomen (7 actually counted), confined mostly to a series along body margin, 1 or 2 of these situated near spiracles, all as large as those of dorsum. Trilocular pores distributed very much as on dorsum except, on thorax, they are confined to isolated patches, along with setae, showing as rather marked "clear areas." A few oral collar tubular ducts scattered over venter of body.

On ventral side a single, small, round circulus present on fourth morphological abdominal segment. Eyes present. Antennae 6-segmented, quite short, stout, apical segment bearing 4 sensory setae; interantennal space equal to

approximately twice width of basal segment. Legs proportionately large and long for members of this genus; claw with long and slender, apically swollen, digitules which are long as claw itself. Mouth parts short and broad. Sclerotized patch present anterior to mouth parts.

NOTES. This new species runs to *Ripersiella amorphophalli* (Betram), (here considered synonymous with *Rhizoecus*) when Hambleton's (1946) key is used. *R. browni* differs in possessing only 1 circulus instead of 2 reticulated circuli which apparently distinguishes *amorphophalli*. In the author's (1960) key to North American *Rhizoecus*, the new form approaches *cacticans* Hambleton, but the presence of multilocular disk pores in *browni* precludes confusion with that species.

I take pleasure in naming this mealybug after Dr. S. W. Brown, who not only collected the species, but also furnished valuable information regarding its habitat.

Rhizoecus gracilis McKenzie, new species

(Figure 12)

Suggested common name. The slender rhizoecus.

Hosts and distribution. Type and paratypes of this species were collected from soil beneath chaparral, Cahill Ridge, San Mateo County, California, May 7, 1960, D. W. Price collector. Examples of it have also been collected in soil 2 miles west of Independence, Inyo County, California, May 6, 1960, by A. S. Menke and F. D. Parker. Specimens here considered to represent this species, designated as paratypes, were found in soil collected at Susanville, Lassen County, California, May 17, 1958, by R. W. Gerhardt.

Type material. Holotype adult female (1 specimen mounted on 1 slide), and paratypes of this species have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis. Paratypes have also been placed in the United States National Collection of Coccoidea at Washington, D.C., and in the collection of the California State Department of Agriculture, Bureau of Entomology, Sacramento.

Habit. No information other than that the mealybug inhabits the soil where it presumably assumes the role of a root feeder.

Recognition characters. Length of mounted adult female is at least 1.00 mm. On dorsum the cerarii are entirely lacking. Anal lobe with several slender setae, these arising from a slightly sclerotized area. Bitubular pores 12 to 16 scattered over abdomen; a few of these present on thorax and head, situated mostly along body margin. Dorsum sparsely beset with trilocular pores and small body setae. Several small, short, oral collar tubular duets scattered mostly on abdomen, a few of these on thorax and head. Multilocular disk pores in small numbers dorsally on eighth abdominal segment. Anal ring borne at apex of abdomen, its 6 setae approximately twice as long as greatest diameter of ring; its pores quite large, elongate-oval, irregularly shaped, clear and open. Dorsal ostioles well-developed.

Ventrally, multilocular disk pores present in moderate numbers from apex to seventh abdominal segments; lacking on thorax and head. Perhaps 1 or 2 bitubular pores may be observed on abdomen venter, none noted elsewhere. Trilocular pores sparsely distributed on venter, confined to isolated patches, along with setae, showing as rather marked "clear areas," particularly on

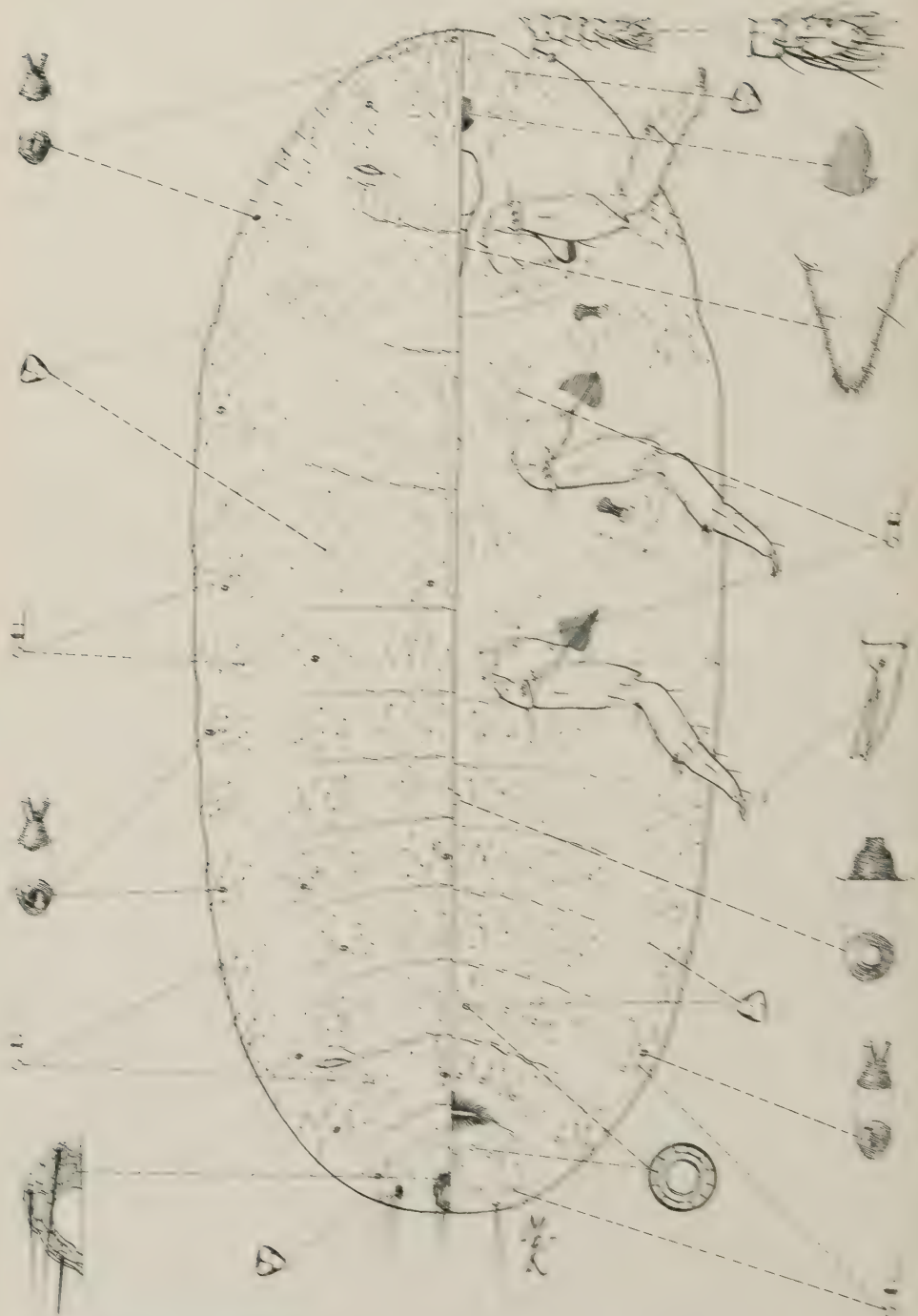


FIG. 12. *Rhizocnus* sp. n. M. Kensie, new species, collected from soil beneath *Agave*, Camel Ridge, San Mateo County, California.

thorax, less so on abdomen. A few of the small oral collar tubular ducts scattered over venter.

On ventral side, single, small, round circulus with reticulated center, is present on fourth morphological abdominal segment. Eyes present. Antennae 6-segmented, quite short, stout, apical segment bears 4 sensory setae; inter-antennal space equal to slightly less than width of basal segment. Legs short, stout; claw with long, slender, apically swollen digitules as long as claw itself. Mouth parts short, only moderately broad. Sclerotized patch present anterior to mouth parts.

NOTES. In Hambleton's (1946) publication on this group, the new species would key to couplet 8 of *Rippersiella* (here considered synonymous with *Rhizoecus*), which includes *solani* Hambleton and *tonicapanus* Hambleton, although it fits neither of these species. It differs from these species principally in the character of the bitubular pores which appear as small sclerotized cones, from the apex of which arise two curving tubes. In *solani* the bitubular pores appear in pairs, these consisting of a pair of tubular pores, the openings of which are set close together, the tubes parallel or somewhat divergent; while in *tonicapanus* these structures appear as strongly divaricating bitubular pores.

Rhizoecus pritchardi McKenzie

An infestation of this species was found on *Saintpaulia* sp. (roots) at Rescue, El Dorado County, California, February 13, 1961, collector not indicated. (Calif. State Dept. Agr. #61B14-82.)

Rhizoecus sonomae McKenzie

An extended series of this species has been collected from soil (ant nest) at type locality, 2 miles west of Petrified Forest, Sonoma County, California, February 15, 1960, by J. S. Buckett. In addition, a single adult female of *sonomae* has been recovered from leaf mold and soil subjected to a Berlese trap, the sample collected 3 miles north of Graton, Sonoma County, California, on February 20, 1960, by C. L. Judson.

An examination of these specimens reveals that 1 or 2 dorsal multilocular disk pores may be present near margin along posterior border of sixth abdominal segment, and that the digitules on claw are knobbed and extend slightly beyond claw tip. These corrections should be noted on original description of the species.

Rhizoecus spinosus McKenzie

Specimens of this mealybug were recently located in the L. E. Myers collection, these taken on *Scabiosa* sp. (Dipsacaceae), in quarantine from St. Helena, Napa County, California, to Santa Monica, Los Angeles County, California, on June 18, 1940, Hamsher, collector.

Spilococcus cactearum McKenzie

Specimens of this mealybug were recently found established on cactus in a nursery at San Diego, San Diego County, California, collected September 15, 1960, by J. R. Carlin (Calif. State Dept. Agr. #60I20-19).

Genus *Trionymus* Berg

One more California species is added to this genus. To the genus there are now assigned 14 species for North America, 10 of which occur in California. A revision of the key to species of this group is here presented.

1. Circulus present 3
- Circulus absent 2
- 2 (1). With cerarii present only on anal lobes; antennae 6- or 7-segmented
 - smithii* (Essig) 4
 - Cerarii present on last 2 abdominal segments; antennae 8- or 9-segmented
 - myersi* McKenzie 4
- 3 (1). With cerarii present only on anal lobes 4
- With more than one pair of cerarii present 7
- 4 (3). Multilocular disk pores of dorsum confined to last 3 abdominal segments
 - bromi* Ferris 5
- Multilocular disk pores scattered over entire dorsum 5
- 5 (4). Multilocular disk pores of abdominal venter unusually numerous, those of segments 5 to 7, medially, arranged in broad bands which are as many as 4 pores deep
 - clandestinus* McConnell 6
- Multilocular disk pores of abdominal venter, medially, in bands nowhere more than 2 pores deep 6
- 6 (5). Body form of adult female narrowly oval *caricis* McConnell
- Body form of adult female broadly pyriform *magnus* (Cockerell and Cockerell)
- 7 (3). Cerarii definitely recognizable only on last 2 abdominal segments 8
- Cerarii definitely recognizable on more than last 2 abdominal segments 14
- 8 (7). Anal lobe cerarius with a distinct surrounding sclerotized area 9
- Anal lobe cerarius definitely without a surrounding sclerotized area 12
- 9 (8). Multilocular disk pores present over entire dorsum *claviger* (King and Tinsley)
- Multilocular disk pores, if present on dorsum at all, confined to abdominal segments 10
- 10 (9). Circulus quite small, normally quadrate-shaped, often divided by segmental line of segments between which it lies; ventral multilocular disk pores lacking on fifth abdominal segment 11
- Circulus small, circular or oval, not divided by segmental line of segments between which it lies; ventral multilocular disk pores normally present on fifth abdominal segment *americanus* (Cockerell)
- 11 (10). Dorsal multilocular disk pores present on last three or four abdominal segments
 - haancheni* McKenzie 13
- Dorsal multilocular disk pores lacking on abdomen *modocensis* Ferris
- 12 (8). Multilocular disk pores in the lateral areas of both thorax and abdomen very numerous 13
- Multilocular disk pores very few or lacking in the lateral areas of both abdomen and thorax *violascens* Cockerell
- 13 (12). Paired setae of anal lobe cerarius short and stout, more or less acorn-shaped; known only from *Phormium* *diminutus* (Leonardi)
- Paired setae of anal lobe cerarius slenderly conical *festucae* (Kuwana)
- 14 (7). Anal lobe cerarius surrounded by a distinct, sclerotized area *dolus* Ferris
- Anal lobe cerarius without a surrounding, sclerotized area *mocus* Ferris

Trionymus myersi McKenzie, new species

(Figure 13)

Suggested common name. Myers mealybug.

Hosts and distribution. Type and paratypes (adult females) collected on *Haworthia* sp. (Liliaceae), Glendale, Los Angeles County, California, January 7, 1946, by M. Wagner. Additional paratypes were also collected on the same host from several other Los Angeles County localities as follows: Los

Angeles, February 26, 1945, F. Bacon and M. Wagner collectors; Pacoima, January 27, 1943, L. E. Myers collector; Pasadena, May 20, 1944, M. Wagner collector; Pomona, April 23, 1941, J. H. Mitchell collector; same city, May 10, 1944, L. E. Myers and J. B. Steinweden collectors; and same city, November 17, 1947, W. D. Dyer collector. Specimens believed to represent this species, and here designated as paratypes, are at hand collected on *Aloe* sp. (Liliaceae), at Delhi, Merced County, California, November 24, 1943, by J. W. Dixon.

Type material. Holotype adult female and paratypes of this species have been deposited in the museum of the University of California, Department of Entomology and Parasitology, Davis. Paratypes have also been placed in the L. Emery Myers collection, Los Angeles County Agriculture Commissioner's Office at Los Angeles; in the collection of the California State Department of Agriculture, Bureau of Entomology at Sacramento; and in the United States National Collection of Coccoidea, Washington, D.C.

Habit. According to L. E. Myers, this mealybug prefers the leaf portion of the plant and not the roots.

Recognition characters. Length of largest available specimen is approximately 2.25 mm. On dorsum number of cerarian pairs reduced, with not more than 2 recognizable pairs, these present on last 2 abdominal segments. Penultimate cerarian spines smaller than anal lobe pair, both anal lobe and penultimate cerarii with auxiliary setae and scattered trilocular pores. Dorsum with numerous oral collar tubular ducts of three distinct sizes, occurring on each abdominal segment, except the last, and on thoracic segments and head. Trilocular pores situated over entire dorsum, sparse in spots. Dorsum without multilocular disk pores except for very few which are scattered about over the abdomen, these pores observed in only 2 of 22 specimens examined. Anal ring of normal form and size for genus, with its 6 setae about twice as long as greatest diameter of ring.

On ventral surface, multilocular disk pores not especially numerous, occurring in an irregular single or double row along posterior borders of segments 8 to 5, a few on anterior border of segments 8 to 7, in area posterior to vulva, and with an occasional pore in lateral areas; these structures lacking on head and thorax except in 1 specimen a single pore noted near clypeus. Oral collar ducts of 2 sizes present, the larger ones more numerous, scattered over entire venter although perhaps more abundant on abdomen. Entire venter sparsely beset with trilocular pores.

Circulus lacking. Antennae normally 9-segmented counting what appears to be a definite division of apical segment, although at times only 8 well-developed segments are present. Legs rather robust, hind femora and tibiae with small translucent pores. Claws without denticle or tooth on plantar surface. Mouth parts fairly broad (see figure 13).

NOTES. Using the author's 1960 revised key to North American species of *Trionymus*, this species would readily run to *smithii* (Essig), because of the absence of a circulus. It is rather closely related to *smithii* but differs in possessing 2 distinct pairs of abdominal cerarii and 9-segmented antennae as compared to only an anal lobe pair of cerarii and 6- or 7-segmented antennae in *smithii*. *Trionymus myersi* McKenzie also differs in having 3

different sizes of dorsal oral collar ducts as compared with only 2 sizes of these structures in *smithii*.

According to L. E. Myers, many of the *Haworthia* plants examined came from Germany and South Africa, which may or may not have been the origin of the mealybug. He reports that some of the varieties were quite heavily infested.

The author takes considerable pleasure in dedicating this species to Mr. L. Emery Myers, Supervising Agricultural Inspector of Los Angeles County, California, who has kindly made available for study purposes his extensive mealybug collection. To him the author expresses his sincere gratitude.

SUMMARY

The objective of this taxonomic study has been to describe and illustrate new California species of mealybugs, and to comment, if necessary, on the taxonomic status of other named forms occurring in the state. Revised keys to North American species have been made to include the new California mealybugs.

Thirteen new California species of mealybugs have been described as follows: *Chorizococcus polyporus*, *C. wilsoni*, *C. yuccae*, *Discococcus spectabilis*, *Phenacoccus dicoriae*, *P. eschscholtziae*, *Puto atriplicis*, *P. echinatus*, *P. laticribellum*, *P. simmondsiae*, *Rhizoecus browni*, *R. gracilis*, and *Trionymus myersi*.

Additional California records of locality and hosts are presented for the following mealybugs previously described by the author: *Chorizococcus wilkeyi*, *Helicococcus adenostomae*, *Phenacoccus graminosus*, *Pseudococcus microcirculus*, *Puto pricei*, *Rhizoecus pritchardi*, *R. sonomae*, *R. spinosus*, and *Spilococcus cactearum*.

ACKNOWLEDGMENTS

Eight of the California species of mealybugs described in this article as new were collected, at one time or another, by various University of California personnel. Four of the new species were made available to the author by the California State Department of Agriculture, Bureau of Entomology, Sacramento, mainly through the efforts of Mr. R. F. Wilkey, Taxonomist; and one species was found in the extensive mealybug collection of Mr. L. Emery Myers, Supervising Agricultural Inspector of Los Angeles County, California. A note of appreciation is here expressed for the splendid coöperation of these individuals and agencies.

ERRATA

The following changes should be made in the first study of this series entitled "Taxonomic Study of California Mealybugs with Descriptions of New Species," published in *Hilgardia*, volume 29, number 15, pages 681-770, illustrated, 1960.

Page 691. Couplet 28 (26). CATAENOCOCCUS Ferris instead of CATENOCOCCUS Ferris.

Page 692. Couplet 41 (40). Last half of couplet should read: At least 4 to 5 pairs of cerarii present on abdomen . . . ORACELLA Ferris

- Page 717. Under *Phenacoccus graminosus*, "Hosts and distribution," line 18—change #53I166 to #53J166.
- Page 729. Under "Hosts and distribution"—omit third, fourth, and fifth sentences. The corrected portion should read as follows: Type and paratypes from orchid (Orchidaceae) in nursery at Lafayette, Contra Costa County, California, October 18, 1954 by D. J. Bingham and J. Simmen (Calif. State Dept. Agr. #54J389) et cetera.
- Page 756. Figure 26—The anterior pair of dorsal ostioles was inadvertently omitted from this illustration. A subsequent examination indicates these structures are definitely present.
- Page 767. Under "Type material," delete third sentence and substitute the following: Entomology and Parasitology Museum Collection at Davis, California; paratypes have et cetera.

